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ABSTRACT

The summary information contained in this report provides teachers, school administrators, students, and the general public with an overview of the results from the January 1997 administration of the Biology 30 Diploma Examination by the Alberta Department of Education in Canada. This information is most helpful when used with the detailed school and jurisdiction reports that have been provided to schools and school jurisdiction offices. Findings indicate that 92.1% of the 7,687 students who took the test achieved the acceptable standard and 22.3% of the students achieved the standard of excellence. Topics discussed include a description of the examination, achievement of standards, results and examiners' comments, multiple-choice and numerical-response questions, and written-response questions. (JRH)

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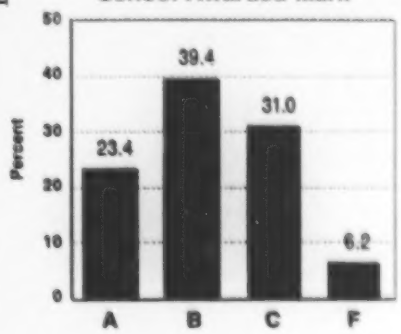
ED 409 192

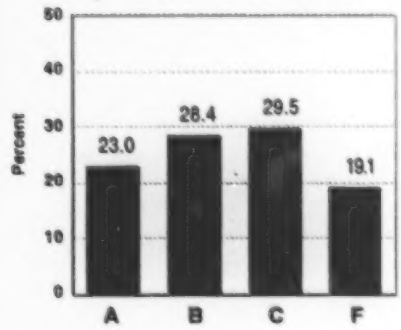
Biology 30

Diploma Examination Results
Examiners' Report for January 1997

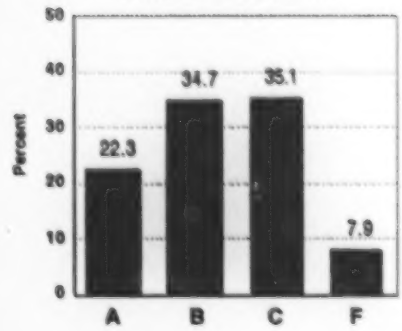
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1997 administration of the Biology 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been provided to schools and school jurisdiction offices. A provincial report containing a detailed analysis of the combined January, April, June, and August results is made available annually.

Description of the Examination

The Biology 30 Diploma Examination consists of 48 multiple-choice questions worth 60%, 8 numerical-response questions worth 10%, and 2 written-response questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 7 687 students in Alberta who wrote the January 1997 examination. This represents an increase of 17 students compared with January 1996, but a decrease of 75 students compared with January 1995.

- 92.1% of the 7 687 students achieved the acceptable standard (a final course mark of 50% or higher).
- 22.3% of the 7 687 students achieved the standard of excellence (a final course mark of 80% or higher).

Student achievement in Biology 30 was very good. The percentage of students who achieved the acceptable standard (92.1%) was greater than the percentage for January 1996 (90.4%). Most students demonstrated a very good understanding of cell division and Mendelian genetics, of differentiation and development, and of population genetics. They demonstrated a good understanding of human reproductive systems and of molecular genetics. Some students had difficulty with concepts related to the nervous and endocrine systems. The majority of students were able to describe and evaluate scientific research procedures well, and they demonstrated a very good understanding of science, technology, and society connections.

Approximately 58.2% of the students who took the course were female. Of this female population, approximately 92.7% achieved the acceptable standard on the course, compared with 91.2% of the male population. The standard of excellence was achieved by approximately 23% of this female population, compared with 21% of the male population.

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Student Evaluation

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Alberta EDUCATION

Provincial Averages

- The average school-awarded mark was 68.6%.
- The average diploma examination mark was 65.3%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 67.3%.

Approximately 9.7% of the students who wrote the examination in January 1997 and received a school-awarded mark had written at least one other Biology 30 Diploma Examination during the January 1996 to August 1996 period. This subpopulation (749) achieved an examination average of 60.3%, compared with 65.8% for the population (6 938) who first wrote the Biology 30 examination in January 1997. However, the group of students who rewrote increased their examination average score from 46.9% to 60.3%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students who achieve the acceptable standard will obtain a mark of 50% or higher and students achieving the standard of excellence will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score achieved by students who wrote the examination.

Questions are also classified by general learner expectations.

Knowledge:

- GLE 1 Nervous & Endocrine Systems
- GLE 2 Reproductive Systems & Hormones
- GLE 3 Differentiation & Development
- GLE 4 Cell Division & Mendelian Genetics
- GLE 5 Molecular Genetics
- GLE 6 Population Genetics & Interaction

Skills:

- SPSC Scientific Process Skills and Communication Skills

Science, Technology, Society:

- STS Connections Among Science, Technology, & Society

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC1	D	0.369	√							√
MC2	A	0.603	√						√	
MC3	A	0.597	√						√	
MC4	A	0.562	√							√
MC5	D	0.622	√							
MC6	A	0.638					√			
NR1	2314	0.697	√							
NR2	5679	0.365		√						
MC7	B	0.897		√						
MC8	A	0.603		√						
NR3	1423	0.665				√				
MC9	B	0.627		√						√
MC10	C	0.675			√					
MC11	A	0.782		√						√
MC12	A	0.521			√					
MC13	A	0.702			√				√	
MC14	B	0.867			√					√
NR4	3421, 2134	0.652			√					√
MC15	D	0.673		√						√

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Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC16	B	0.704		√						
MC17	B	0.691		√						
MC18	A	0.332					√			
MC19	C	0.896			√					
MC20	C	0.698					√		√	
MC21	A	0.640					√		√	
MC22	C	0.703					√			
MC23	B	0.658					√		√	√
MC24	A	0.837					√		√	√
MC25	D	0.623					√			√
MC26	C	0.800				√			√	
MC27	C	0.685				√			√	
MC28	A	0.735				√			√	
MC29	A	0.736				√				
MC30	C	0.616				√				
MC31	D	0.766				√				
MC32	C	0.826				√				√
MC33	A	0.787				√				√
MC34	C	0.833				√			√	
MC35	B	0.844				√			√	
NR5	25	0.426				√			√	
MC36	D	0.766				√			√	
MC37	A	0.712					√		√	
NR6	0.25	0.452				√			√	
MC38	D	0.811				√				√
NR7	0.50	0.760				√			√	
MC39	C	0.854				√				√
MC40	B	0.821				√				
NR8	213, 312	0.784				√			√	
MC41	A	0.726				√				
MC42	D	0.479						√		
MC43	C	0.429						√	√	
MC44	D	0.727						√		√
MC45	D	0.760						√	√	
MC46	A	0.852						√		
MC47	A	0.787						√		
MC48	D	0.796						√		
WR1	–				√			√	√	√
WR2	–		√						√	√

Subtests

When analyzing detailed results, bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

Machine Scored: 38.5 out of 56

General Learner Expectations

GLE 1	Nervous & Endocrine Systems	3.4	out of	6
GLE 2	Reproductive Systems & Hormones	5.3	out of	8
GLE 3	Differentiation & Development	4.3	out of	6
GLE 4	Cell Division & Mendelian Genetics	14.7	out of	20
GLE 5	Molecular Genetics	5.9	out of	9
GLE 6	Population Genetics & Interaction	4.8	out of	7
Skills		13.7	out of	20
STS		10.7	out of	15

Multiple choice: 33.7 out of 48

Numerical response: 4.8 out of 8

Written Response: 13.6 out of 24

Question 1: 7.3 out of 12

Question 2: 6.1 out of 12

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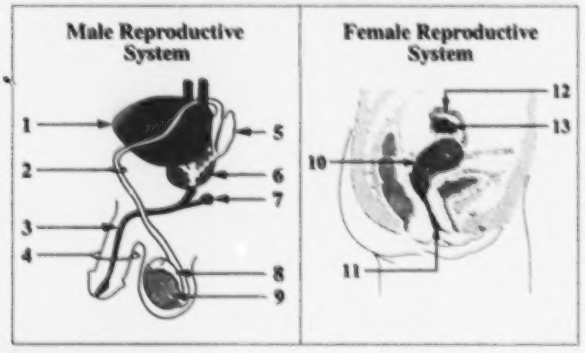
Certain compounds known as opiates (opium, morphine, and codeine) are addictive drugs. Scientists have found that opiates work by binding to specific sites in the brain that interpret perceptions of pleasure and pain.

1. A likely explanation of how receptors in the human brain are stimulated by opiates is that opiates

   A. bind to neurotransmitters
   B. act in the same way as cholinesterase
   C. increase the strength of action potentials
   •D. have molecular shapes similar to a neurotransmitter

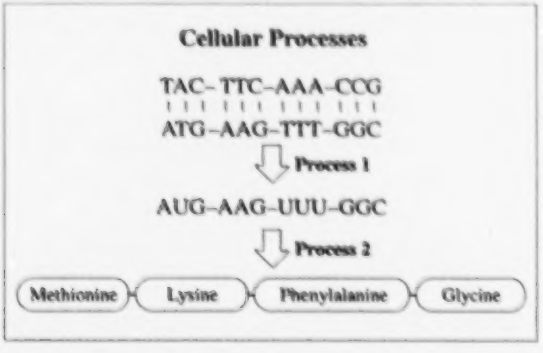


Numerical Response

2. What are the structures that are responsible for the **production** of the components of semen?

(Record your **answer in lowest-to-highest numerical order** in the numerical-response section of the answer sheet.)

Answer: 5679



21. Which row correctly identifies processes 1 and 2 and indicates the locations in which these processes occur?

Row	Process 1	Process 2
•A.	transcription—nucleus	translation—cytoplasm
B.	translation—cytoplasm	transcription—nucleus
C.	translation—nucleus	transcription—cytoplasm
D.	transcription—cytoplasm	translation—nucleus

Multiple-Choice and Numerical-Response Questions

Multiple-choice question 1 required students to choose a likely explanation for how opiates stimulate receptors. When faced with choosing between a plausible distracter and the answer, overall students had difficulty. Only 36.5% chose the correct answer, but 42.2% chose alternative A. However, 65.5% of students achieving the standard of excellence demonstrated that they understood that opiates likely stimulate receptors because they have molecular shapes similar to neurotransmitters.

Numerical-response question 2 required students to choose the set of structures responsible for the production of semen. The four structures involved are the epididymis, the seminal vesicles, the prostate gland, and the Cowper's glands. Approximately 88% of students knew that the seminal vesicles were involved in semen production; approximately 72% knew that the prostate gland was involved; approximately 78% knew that the Cowper's glands were involved; and approximately 79% knew that the testes were involved. Only 36.7% of students were able to choose all four of these structures; however, 70.9% of students achieving the standard of excellence demonstrated this knowledge.

Multiple-choice question 21 required students to identify the processes of transcription and translation, and their respective locations in the cell. Overall, 64.2% of students demonstrated an understanding that transcription occurs in the nucleus and translation occurs in the cytoplasm in this multiconcept question. Of students achieving the standard of excellence, 88.8% chose the correct answer as did 70.4% of those achieving an acceptable standard.

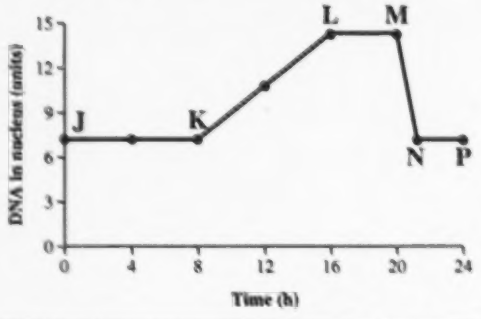
During **the cell cycle**, cells in growing tissue normally progress through **interphase**:

- stage 1—cells grow, carry out normal metabolism, and produce more organelles
- stage 2—DNA replication, chromosome duplication, and cell growth occur
- stage 3—cell growth occurs

and **mitosis**.

Human cells were cultured for a day in a nutrient-rich medium. The DNA content of a typical nucleus was determined every hour, and the data collected were graphed.

DNA Content of the Nucleus Over Time



27. On the graph, N likely indicates the completion of which mitotic event?

A. Prophase
B. Anaphase
•C. Telophase
D. Metaphase

Chromosome Number of a Horse	
Horse, *Equus caballus*	66 (2n)

30. Starting from a single cell, spermatogenesis in horses produces

A. one cell with 33 chromosomes
B. two cells, each with 66 chromosomes
•C. four cells, each with 33 chromosomes
D. three cells, each with 22 chromosomes

Numerical Response

5. What percentage of the gametes produced by a pea plant heterozygous for both seed shape and seed colour would be expected to contain both the allele for wrinkled and the allele for green?

(Record your **answer as a whole number** in the numerical-response section of the answer sheet.)

Answer: 25%

Multiple-choice question 27 required students to identify the name of the mitotic event completed at a point in time as diagrammed on a graph. Only 68.6% of students identified the mitotic event as telophase. Interestingly, in question 26, 80.1% of students were able to identify the cellular activities occurring during a particular mitotic event at another point in time on this graph. It appears that categorizing cellular activities into particular named mitotic events is more difficult for students than identifying mitotic cellular activities at points in time.

Multiple-choice question 30 required students to select the response that demonstrated their understanding of meiosis as exemplified by spermatogenesis. Most students achieving the standard of excellence (94.7%) correctly selected alternative C, thereby demonstrating that they understood that spermatogenesis in horses resulted in the production of four cells with a haploid chromosome number. However, only 61.8% of all students who wrote the exam were able to correctly answer this question.

Numerical-response question 5 required students to calculate the percentage of gametes produced by a heterozygote. Only 42.7% of students demonstrated that 25% of the gametes would contain both recessive alleles. Approximately 13% answered 50%, indicating that they likely do not understand that a heterozygote has four, not two, possible gametes. Approximately 11% answered 56%, indicating that they had completed a heterozygote cross and counted $\frac{9}{16}$ or 56% of the offspring with both recessive alleles. Fourteen students answered 9%, indicating a similar mistake, and 5% answered .25, 0.25, or 2500, indicating that they likely knew the answer but did not express it correctly.

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Huntington's disease is a disorder in which two regions of the brain that help control body movement are destroyed; therefore, the diseased body is in perpetual motion. Huntington's disease is thought to have originated as a single **dominant** gene mutation on **chromosome 4** in a small population in northwestern Europe. The disease is spread through inheritance since new mutations are very rare. One in every 10 000 people has the gene.

Numerical Response

6. A man who is hetrozygous for the disease allele marries a woman who is homozygous for the normal recessive allele. What is the probability that their first child is a boy and has Huntington's disease?

(Record your **answer as a value from 0 to 1, rounded to two decimal places,** in the numerical-response section of the answer sheet.)

Answer: 0.25

Four babies were born in a hospital on the same day. Due to a mix-up at the hospital, there was some confusion as to the identity of the babies.

	Mother	**Father**
Parents 1	Type A	Type O
Parents 2	Type AB	Type B
Parents 3	Type O	Type B
Parents 4	Type AB	Type O

	Blood Type
Baby W	Type A
Baby X	Type B
Baby Y	Type AB
Baby Z	Type O

Numerical Response

7. The probability that a mother with blood type O and a father with the genotype $I^B i$ would have a child with blood type O is _____.

(Record your **answer as a value from 0 to 1, rounded to two decimal places,** in the numerical-response section of the answer sheet.)

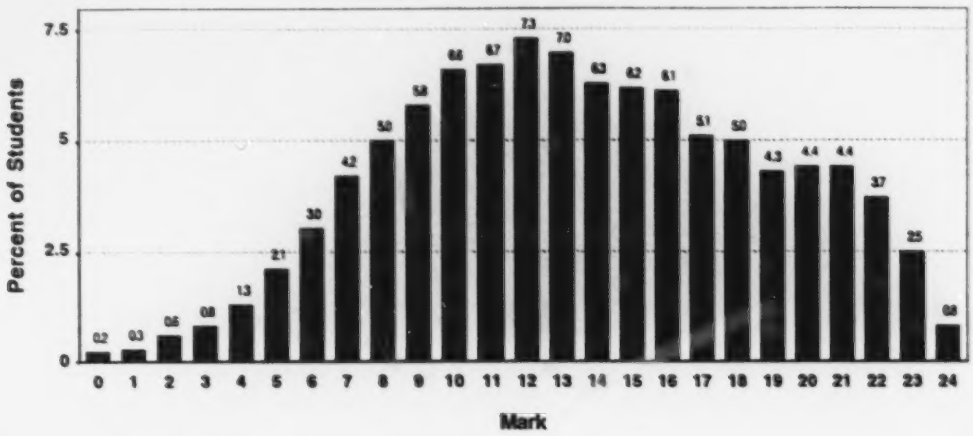
Answer: 0.50

Numerical-response questions 6 and 7 required students to predict the probability of the phenotype of offspring of two different given crosses. However, question 6 required students to predict the probability of the sex as well as the particular phenotype, whereas question 7 did not. Only 45.3% of students were able to correctly predict that the probability of a male offspring with Hungtington's disease was 0.25, whereas 76.3% were able to predict that the probability of a blood type O offspring was 0.50. For question 6, approximately 26% of students answered 0.50, indicating that they did not combine the probabilities for both phenotypes. The difference in difficulty between the two questions was 31%, indicating that question 7 was likely an easier question by 5% than was 6 without combined probabilities and that combining probabilities is difficult for students. Question 7 was based on blood type genotypes and phenotypes, a specific learner expectation in the program of studies. Question 6 was based on Huntington's disease, an application of a specific learner expectation in the program of studies.

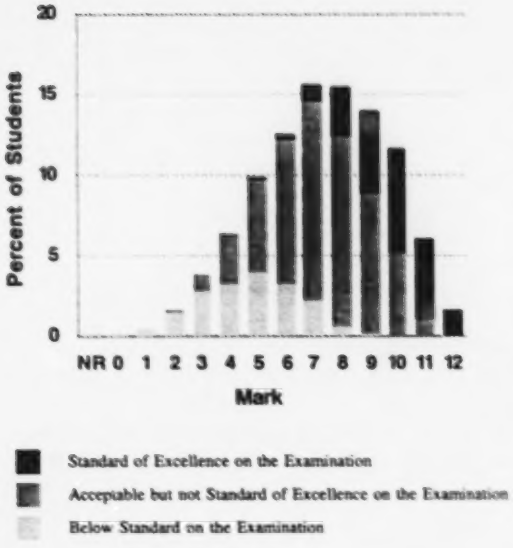
Written-Response Questions

Of the students who wrote the examination, 0.2% received no marks for both written-response questions, 63.3% received 12 marks or more out of 24, and 15.8% received 20 marks or more out of 24.

Distribution of Marks for Written Response



Distribution of Marks for Question 1



Question 1: Almost all students (99.6%) who wrote the examination achieved some marks on this process skill question. This question related to the lynx–snowshoe hare relationship.

Subparts of the question required students to analyze data, make calculations of density and per capita growth rate, identify possible causes, classify, make predictions, and describe factors affecting the lynx–snowshoe hare study or relationship.

In part a, most students were able to choose the correct formula from the data sheets, however, students had difficulty calculating the area of the study.

In part b, few students were able to calculate the per capita growth rate. A common mistake made by many students was to use the value of the final population instead of the initial population for N.

In parts c and e, students demonstrated that they have a good understanding of the predator–prey relationship of the lynx and the snowshoe hare.

In part d, few students were able to explain how the gene pool of a population is affected by immigration.

In part e, few students were able to indicate how environmental resistance on the hare was changed by hunting fewer lynx.

In part f, many students demonstrated a good understanding of reproductive physiology.

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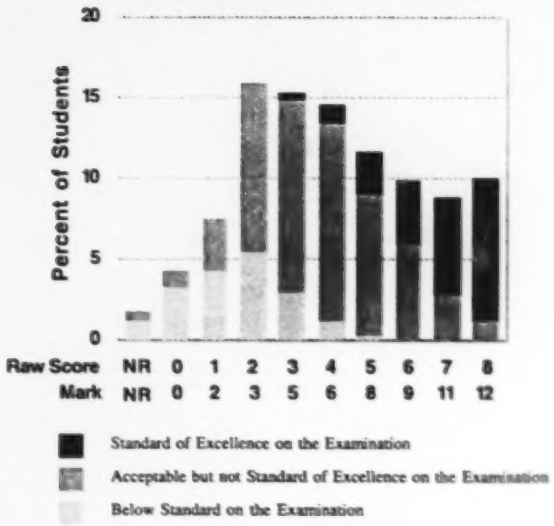
Distribution of Marks for Question 2


20
15
10
5
0
Percent of Students
Raw Score NR 0 1 2 3 4 5 6 7 8
Mark NR 0 2 3 5 6 8 9 11 12
Standard of Excellence on the Examination
Acceptable but not Standard of Excellence on the Examination
Below Standard on the Examination

In part *g*, some students were unable to differentiate between ecologists' field technologies and laboratory technologies.

In part *h*, most students understood that lynx were K-selected, and they identified characteristics of K-selected species.

On this 12-mark question, the average mark was 7.3 or 60.8%. The acceptable standard on this question was achieved by 77.2% of the student population, with 19.4% achieving the standard of excellence. Of the female students who wrote the examination, 77.3% achieved the acceptable standard and 19.2% achieved the standard of excellence. The average mark on this question for the female population was 60.6%. Of the male students who wrote the examination, 77.0% achieved the acceptable standard and 19.8% achieved the standard of excellence. The average mark on this question for the male population was 61.1%.

Question 2: Almost all students (98.2%) who wrote this examination achieved some marks on this essay question. The question required students to describe a stressful experience, explain sensory reception in two organs, trace the impulse pathway to a specific region of the cerebrum, describe physiological responses in body systems that help the body cope with stress, and describe two technologies that either enhance sensory perception or help deal with the stress described.

The majority of the students described a personal stressful experience very well. Most students explained sensory reception in one organ, (usually the eye), and partially explained sensory reception in another organ, (usually the ear). Some students traced the impulse pathway to a specific region of the cerebrum, but the majority did not. Some students explained a reflex arc without connecting their explanation to the overall question. The majority of the students described physiological responses in body systems, (usually the release of epinephrine or the stimulation of the sympathetic nervous system), that help the body cope with stress. Most students could describe two technologies that would help them deal with the stress they chose. The majority of the students used complete sentences and developed a well-constructed, unified response.

This question was marked holistically. Two markers read each response, and each assigned a score from 0 to 4. These scores were added to obtain a raw score from 0 to 8. This raw score was then converted to a mark out of 12. On this 12-mark question, the average mark was 6.1 or 50.8%. The acceptable standard on this question was achieved by 55.0% of the student population, with 18.8% achieving the standard of excellence. Of the female students who wrote the examination, 54.7% achieved the acceptable standard and 18.4% achieved the standard of excellence. The average mark on this question for the female population was 50.4%. Of the male students who wrote the examination, 55.4% achieved the acceptable standard and 19.4% achieved the standard of excellence. The average mark on this question for the male population was 50.5%.

For further information, contact Karen Slevinsky (kslevinsky@edc.gov.ab.ca) or Phill Campbell (pcampbell@edc.gov.ab.ca) at the Student Evaluation Branch at 427-0010. To call toll-free from outside of Edmonton, dial 310-0000.

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